Elasticity of Long Distance Travelling

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ABSTRACT

With data from the Danish expenditure survey for 12 years 1996 through 2007, this study analyses household expenditures for long distance travelling. Household expenditures are examined at two levels of aggregation having the general expenditures on transportation and leisure relative to five other aggregated commodities at the highest level, and the specific expenditures on plane tickets and travel packages at the lowest level. The Almost Ideal Demand System is applied to determine the relationship between expenditures on transportation and leisure and all other purchased non-durables within a household. Due to a high share of corner solutions among the expenditures on plane tickets and package travelling, the expenditures on these specific commodities are examined with a Tobit approach. The model results find both plane tickets and travel packages to be luxury goods. It also states that travel packages has higher income elasticity of demand than plane tickets but also higher than transportation and leisure in general. The findings within price sensitiveness are not as sufficient estimated, but the model results indicate that travel packages is far more price elastic than plane tickets which are actually found close to be unit elastic.

1 INTRODUCTION

Within the transportation research field, the relevance of long distance travelling has increased as transport models in general have increased in proportions as well as in details. Generally, most focus is put on daily transportation even though the relative limited number of outbound travel represent approximate 40 percent of the total travelled kilometres (Knudsen, 2010). Apart from composing a significant share of the total amount of travelling, holiday travel is most likely sensitive to economic changes and hence very relevant when forecasting the future amount of travelling. It is of high relevance to improve the knowledge of the interactions between the

amount of travelling and general economic changes in society in order to forecast long distance travelling.

Due to the available data, private expenditures on plane tickets and travel packages will act as a mean to analyse consumption on long distance travel even though several other types of travelling also seems relevant. These are however not isolated described within this data.

The paper is structured as follows. In the next section, the formulation of the two applied models are outlined and in Section 3 the survey is described including an overall descriptive analysis of the commodities of most interest. In Section 4 the final model specifications are listed and Section 5 presents the results of the estimations. Finally in section 6 the findings are summarised with some concluding remarks.

2 MODELLING FRAMEWORK

In order to analyse the expenditure shares of aggregated commodities the Almost Ideal Demand System (AIDS, Deaton and Muellbauer, 1980) is applied. AIDS is one of the most widely used approaches for estimating empirical demand systems in consumer demand analysis (see e.g. Chern, 2003; Hausman, 1997; Chang, 2010). The model system is an extension of the Working-Leser model (Working, 1943; Leser, 1963) in which the budget share of good i is linearly related to the logarithm of prices and total real expenditures. This system approach has an advantage over the single equation approach in estimating empirical demand systems as it can analyse the interdependence of budget allocations for different consumer goods and services.

The expenditure share w_i associated with the i-th good provides the general form of the AIDS model (1):

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log\{X/P\} \tag{1}$$

where $p_j = (p_1, \cdots, p_j)$ is the price vector of all goods included in the model, X is the total household expenditure and P is a nonlinear price index given by (2). α, β and γ are the parameters to be estimated.

$$\log P = \alpha_0 + \sum_i \alpha_i \log p_i + \frac{1}{2} \sum_i \sum_j \gamma_{ij} \log p_i \log p_j \tag{2}$$

where $\gamma_{ij} = \gamma_{ji}$

Due to well-known properties of an expenditure function (see, e.g., chapter 3 in Mas-Colell, 1995) the parameters γ_{ij}, α_i and β_i must satisfy the restrictions listed in (3) and (4):

homogeneity $$\sum_j \gamma_{ij} = 0 \tag{3}$$

adding up $$\sum_{i=1}^{n} \alpha_i = 1 \qquad \sum_{i=1}^{n} \gamma_{ij} = \sum_{i=1}^{n} \beta_i = 0 \tag{4}$$

Changes in relative prices work through the γ_{ij} parameters and changes in expenditures operate through the β_i parameters. The adding up restrictions ensure that the sum of β_i adds up to zero. In the model, β_i being positive means that the income elasticity is above 1, whereas β_i being negative means elasticity below unity. In this way, positive values of β_i correspond to luxury goods whereas negative values correspond to necessities (Deaton and Muellbauer, 1980).

The underlying theory of AIDS assumes no corner solution among individuals, i.e. each household is assumed to have expenditures on all commodities. This implies that the model system is mainly appropriate for aggregated expenditure data. When looking at a detailed expenditure portfolio within a limited time frame, zero consumption may occur. In that case, additional conditions or other approaches need to be considered (see, e.g., Brännlund and Nordström, 2002; Chern *et al.*, 2003). Even so, the AIDS approach has been widely applied on more disaggregated goods even as specific as brands (see, e.g., Hausman, 1997) by estimating AIDS to analyse the demand for cereal products.

The most commonly applied models to account for zero expenditure shares are Heckman's two step model (Heckman, 1979) and the standard Tobit model (Tobin, 1958; Ameiyda, 1974). Each model is based on different assumptions regarding zero consumption.

If zero consumption is assumed to be due to sample selection, in the sense that no purchase of the particular item was made during the survey period (e.g., because of a short survey period), Heckman's two-step model is the appropriate model. The Tobit model on the other hand simply captures the corner solutions for utility maximisation, where zero actually represents no expenditures on the specific good (Brännlund and Nordström, 2002).

In the present expenditure survey to be described in Section 3, zero consumption might easily occur as a combination of both sample selection and "true" zero consumption for certain household types. For a significant share of the included commodities, data are collected within a two weeks period, and hence the probability of having the corner solution representing infrequency of purchase is high. However, some specific and rare commodities (especially

durables) are also likely to actually have zero consumption within some households during a particular period of observation. Chern *et al.* (2003) handle this difference in explaining corner solution by applying both the Heckman and the Tobit approach to outline a probable interval span of the elasticities. Due to the purchase of plane tickets and travel packages, it is reasonable to assume that the corner solutions actually correspond to zero expenditures and this is the reason why the Tobit model is applied.

The Tobit approach is an econometric model for censored endogenous variables proposed by James Tobin (Tobin, 1958). It was developed to describe the linearly relationship between the non-negative dependent variable w_i, and a linear predictor βz_i. The Tobit model is:

$$w_i = \begin{cases} w_i^* & if\ w_i^* > 0 \\ 0 & if\ w_i^* \leq 0 \end{cases} \tag{5}$$

where w_i^* is the latent variable: $w_i^* = \beta z_i + \varepsilon_i,\ \varepsilon_i \sim N(0, \sigma^2)$.

The specification of w_i^* in this study is based on the model specification of the expenditure shares used in AIDS though without applying the general price index P, cf. (6)[1]:

$$w_i^* = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log \mathrm{X} + \varepsilon_i \tag{6}$$

3 DATA

The modelling effort in the present paper is based on the Danish expenditure survey. The survey registers the total expenditure of Danish households divided into approximately 1,300 commodities. Data cover a 12-year period from 1996 to 2007 and include expenditure information from approximately 900 households per year extracted as a representative sample of the population. For all households, detailed background information is available, including among other things information about composition and income.

The survey only registers total expenditures on the different commodities and does not provide any information on unit prices or product quantities. Instead, prices from the national Price Index

[1] The stochastic process of the Tobit model determines in this case expenditure shares and the discrete switch at zero.

have been used (Statistics Denmark, 2011). These prices are divided into similar classifications of commodity groups as applied in the model.

Table 1 below shows some properties of the six aggregated commodity groups applied in the model. Plane and travel packages are included in the relative broad defined commodity group of transportation and leisure which accounts for 43 percent of the total expenditures. All expenditures are corrected for inflation and possible outliers are removed from the survey.

TABLE 1 – DATA PROPORTIES WITHIN THE SIX OVERALL COMMODITY GROUPS

	Obs.>0	Share of zero cells	Average Expenditure share	Average yearly change in expenditure shares	Average yearly change in prices	Average yearly change in total quantities
Food, drinks and tobacco	9,538	0 %	25 %	-2.2 %	1.6 %	0.9%
Clothes and footwear	7,870	17 %	7 %	-0.7 %	-1.4 %	2.6%
Electricity and heating	9,507	0 %	15 %	1.3 %	3.8 %	4.5%
Medicine and medical care	8,699	9 %	3 %	2.4 %	1.3 %	6.4%
Communication and audio equipment	9,474	1 %	7 %	0.5 %	-4.3 %	3.6%
Transportation and leisure	9,538	0 %	43 %	0.6 %	2.6 %	4.1%

The four top commodity groups correspond to the overall grouping from the expenditure survey, whereas the final two commodity groups are rearrangements of the original commodity groups to have plane and travel packages within the same group. Besides long distance travel, this commodity group contains very different commodities such as toiletries, daily transportation, expenditures on pets, education etc. The price index applied is estimated as a weighted average from market shares found in the expenditure survey and is hence biased.

The total expenditures applied in the model are the total expenditures on the non-durables listed in Table 1. The durables include housing expenditures, house equipment, purchase of cars and other means of transport, while large consumer durables for leisure activities are excluded from the survey. Since the durables are excluded from the survey, the model specification implies that there is no substitution between durables and non-durables.

During the 12-year survey period, the expenditure share of food, drinks and tobacco decreases whereas the total quantities purchased of drinks and tobacco are relatively stable. This implies a general increase in disposable income resulting in increased consumption on other goods and services. The stated quantities in the table are total quantities describing the total unit purchased within the commodity group derived from total expenditures divided by the price index. Hence,

this figure does not describe changes in actual quantities purchased or changes in quality of the goods.

Generally, the total quantity increases within each commodity group, but the yearly increase of 4.1 percent within transportation and leisure compared with the high expenditure share indicates that quite a substantial share of the extra disposal income is spent for transportation and leisure.

3.1 Long distance travel

The commodities having most interest are the plane tickets and travel packages. These two commodities act as instruments for the analysis of long distance travel even though they do not describe all outbound travel.

Figure 1 and Figure 2 show some properties of the two commodities. Figure 1 shows the development in the prices of travelling from 1996 to 2007 compared with the general price index. Figure 2 shows the changes in expenditure shares of the two commodities and an aggregated travel commodity.

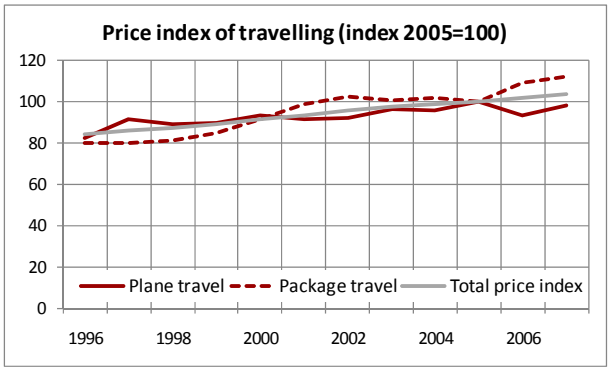

FIGURE 1 – DEVELOPMENT IN THE PRICE INDICES OF PLANE AND TRAVEL PACKAGES HAVING 2005 AS BASE YEAR

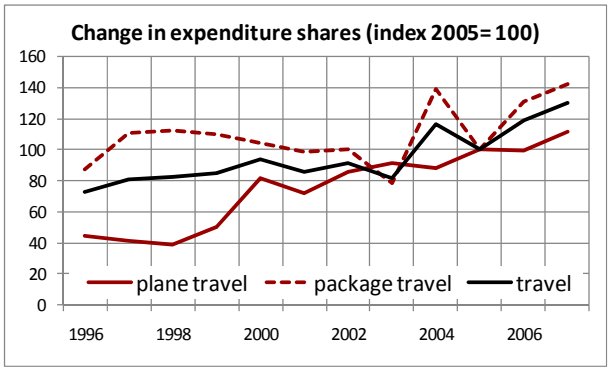

FIGURE 2 – DEVELOPMENT IN EXPENDITURE SHARES OF PLANE TRAVEL AND TRAVEL PACKAGES HAVING 2005 AS BASEYEAR

The prices of plane tickets and travel packages have increased by 1.6 and 3.1 percent per year, respectively. The prices of travel packages have increased somewhat more than the 1.9 percent yearly change in the total price index. The changes in expenditure shares are higher than the changes in prices. In total, travelling have increased by 5.4 percent per year, whereas plane tickets have increased by 8.7 percent and travel packages only by 4.5 percent. This very high growth in budget shares should be considered relative to the very small average expenditure shares of 0.5 and 1.8 percent, respectively.

The total expenditures on most of the commodities are registered within a two weeks period, but the consumption on more infrequent commodities is registered within a year. That is the case for

plane travel and travel packages ensuring a higher sample. Still, only 13 and 28 percent of the households register expenditures on plane tickets and travel packages, respectively. Combining the two commodities to an overall travel commodity, only 38 percent of the households register expenditure on travelling.

This high share of non travellers does not reflect the general share of non travellers within the population since for example car travelling is not included. From statistic Denmark's registration of "Business and holiday travel 2007" (Statistic Denmark, 2008), it appears that approximately 40 percent of the population have holidays with plane as primary mode. Due to this it seems reasonable to assume that the high number of corner solutions is probably not due to sample selection which justifies the Tobit approach over Heckman's.

4 MODEL SPECIFICATION

The model estimation is separated into two parts: firstly, the overall elasticities are estimated with the AIDS model for the six commodity groups described in Section 3; secondly, long distance travel is analysed in more detail with the Tobit model.

The expenditure functions applied in both cases are similar linear relations describing the observable expenditure shares as a function of the logarithm of prices and the logarithm of total expenditures. The AIDS model is derived from the Working-Leser model and to include heterogeneity in population, six household specific constants are applied to the model specification as in (7):

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log\{X/P\} + \sum_k \delta_i H_k \tag{7}$$

The applied model specification in the Tobit model is also based on the Working-Leser specification and the same household specific constants are applied to include heterogeneity:

$$w_i = \begin{cases} w_i^* & if \quad w_i^* > 0 \\ 0 & if \quad w_i^* \leq 0 \end{cases} \tag{8}$$

where

$$w_i^* = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log \mathrm{X} + \sum_k \delta_i H_k + \varepsilon_i$$

The vector H_k includes the six household specific constants, where the household members are grouped into five age groups: babies up till two year olds, small children before starting in school (3-6), children before the teens (7-11), teens (12-17) and all household members above 17 are grouped as grownups. The final variable is the number of retired persons in the household.

Furthermore, a dummy variable representing singles was tested but with very limited impact. A time trend dummy was also implemented, but it was found to be insignificant.

5 RESULTS

The results are divided into two parts reflecting the two applied approaches; the results of the aggregated AIDS model describing the overall relations between commodities, and the disaggregated Tobit mode describing the demand for travelling.

5.1 Aggregated AIDS estimation

Table 2 shows the parameter estimates from the AIDS approach as described in Section 2. Due to the level of aggregation in the commodity groups, the problem of corner solutions can be ignored.

TABLE 2 - PARAMETER ESTIMATES OF THE AGGREGATED AIDS MODEL

	Food, drinks and tobacco	Clothes and footwear	Electricity and heating	Medicine and medical care	Communication and audio Equipment	Transportation and leisure
$\gamma_{Food,drinks\ and\ tobacco}$	-0.0178	0.0570**	0.0630*	0.0550**	0.00923	-0.166**
$\gamma_{Clothes\ and\ footwear}$	0.0570**	-0.0494	-0.116**	0.00491	0.0292**	0.0748*
$\gamma_{Electricity\ and\ heating}$	0.0630*	-0.116**	-0.0277	-0.0251	0.0160	0.0902
$\gamma_{Medicine\ and\ medical\ care}$	0.0550**	0.00491	-0.0251	-0.0190	-0.0189*	0.00301
$\gamma_{Communication\ and\ audio}$	0.00923	0.0292**	0.0160	-0.0189*	-0.0318**	-0.00377
$\gamma_{Transportation\ and\ leisure}$	-0.166**	0.0748*	0.0902	0.00301	-0.00377	0.002294
β_i	-0.0760**	0.0410**	-0.0540**	0.00483**	-0.0151**	0.0994**
α_i	0.548**	-0.118**	0.412**	0.00974**	0.165**	-0.0165
Babies (0-2 years)	0.00492	0.00544*	0.00242	-	-0.0102**	0.00115
Small children (3-6 years)	0.00960**	0.000923	0.00327	-	-0.00783**	-0.00219
Children (7-11 years)	0.0176**	-0.00206	0.00684**	-	-0.00316**	-0.0139**
Teens (12-17 years)	0.0240**	0.00452**	0.00705**	-	0.00428**	-0.0373**
Grownups (above 17 years)	0.0372**	-0.0179**	0.00307*	-	-0.00331**	-0.0165**
Retired persons	0.00492	-0.00628**	0.0251**	-	-0.0162**	-0.0287**

** and * indicate that estimates are significantly different from zero at the 0.05 and the 0.10 level respectively

The estimation of the price related parameters suffers from lack of variability in prices. As aforementioned in Section 3, prices are measured on the basis of average price index for the

commodity group (over time) and are not specific to individuals. However, the model estimation appears reliable and the remaining model parameters are generally significant with a high level of confidence.

All β parameters are estimated with high confidence and provide a good basis for the estimation of income elasticities. Obviously this is due to the fact that income is household specific in contrary to prices and hence includes much more variation. Income elasticities can be measured as:

$$e_i = \frac{\beta_i}{w_i} + 1 \tag{9}$$

Table 2 shows the estimated income elasticities and for comparison also a number of estimates from the USDA-Economic Research Service calculation using 2005 ICP data (ICP, 2005). All the commodity groups applied in the two sets of estimations are not completely identical, but the food, clothes and medicine commodities are apparently the same.

TABLE 3 – INCOME ELASTICITY ESTIMATED FROM THE RESULTS OF THE AIDS MODEL

	Food, drinks and tobacco	Clothes and footwear	Electricity and heating	Medicine and medical care	Communication and audio Equipment	Transportation and leisure
Income elasticity	0.694	1.605	0.638	1.147	0.785	1.230
USDA	*0.516*	*0.964*	-	*1.24*	-	*1.1-1.3*

The aggregated AIDS model finds the three commodity groups: food, drinks and tobacco, electricity and heating, and communication and audio equipment to be necessities. Clothes and footwear, medicine and medical care, and transportation and leisure are estimated to be luxury goods. In the USDA estimations, the income elasticity of clothes and footwear are found to be approximately one. This difference might be due to a significant share of corner solutions, which will tend to upward bias the corresponding elasticity in the AIDS model.

5.2 Tobit estimation of plane tickets and travel packages

As mentioned in Section 3, only 39 percent of the households have registered consumption on plane tickets or travel packages during the year they participated in the survey. Due to this, applying an AIDS on these disaggregated commodities is theoretically unsuitable. Instead, the Tobit model described in Section 2 is applied.

As were the case for the aggregated AIDS estimation, the estimation of the Tobit model also suffers from the lack of price variation in the data. The Tobit model is modelled as a multivariate model system of the budget shares of plane tickets and travel packages relative to the total expenditures on travelling.

Table 4 shows the parameter estimates of the model system. Most parameters are significant and, as for the aggregated AIDS model, the β parameters are estimated with high confidence and thereby give a good basis for the estimation of income elasticities. As can be seen, the own price related parameter for plane tickets has not been significant estimated. But the standard error is though too high assume the estimate equal zero.

Obviously, the lack of price variation is a problem for the identification and interpretation of price elasticities. However, it does not prevent the estimation of income elasticities that are correct on average as long as the separability of the Tobit equation in terms of X and p holds.

As the model estimates are the result of a Tobit approach, the interpretation of the parameters is not completely parallel with the traditional interpretation of the parameters. These parameters also represent the latent choice of actually purchasing the specific good.

TABLE 4 – MULTIVARIATE TOBIT MODEL SYSTEM OF PLANE TICKETS AND TRAVEL PACKAGES WITHOUT ANY MODEL RESTRICTIONS

	Plane tickets	Travel packages
$\gamma_{Plane\ ticket}$	0.819	-0.555**
$\gamma_{Travel\ pakages}$	1.024**	-1.350**
β_i	1.125**	0.601**
α_i	-1.198**	-0.802**
Babies (0-2 years)	0.0808	-0.169**
Small children (3-6 years)	-0.0938*	-0.0818**
Children (7-11 years)	-0.171**	-0.0893**
Teens (12-17 years)	-0.132**	0.0180
Grownups (above 17 years)	-0.0831**	-0.0834**
Retired persons	-0.292**	-0.0360**
ε_i	1.125**	0.665**
ρ	-0.696**	

** and * indicate that estimates are significantly different from zero at the 0.05 and the 0.10 level respectively

The household specific constants included in the model in general show that an increasing number of household members have negative impact on the expenditure shares of plane tickets and travel packages. The number of retired household members has the highest impact on the purchase of plane tickets, whereas the existence of babies in the household has the highest impact on travel packages.

The significant ρ indicates existence of correlation between the purchase of plane tickets and travel packages. This justifies the multivariate model system instead of two separate univariate Tobit models.

Where unconditional elasticity represents the whole population hence also includes the households having zero expenditure, the conditional elasticity reflect the econometric relations for travellers rather than the whole population. The conditional elasticities are estimated from the relations in (10), (11) and (12).

$$e_i = \frac{\partial E[q_i|q_i^* > 0]}{\partial X}\frac{X}{E[q_i|q_i^* > 0]} = 1 + \frac{\hat{\alpha}_i\left[1 - \hat{z}_i\frac{\phi(\hat{z}_i)}{\Phi(\hat{z}_i)} - \left(\frac{\phi(\hat{z}_i)}{\Phi(\hat{z}_i)}\right)^2\right]}{\bar{x}_i\hat{\beta} + \hat{\sigma}_i\frac{\phi(\hat{z}_i)}{\Phi(\hat{z}_i)}} \tag{10}$$

$$e_{ii} = -1 + \frac{\hat{\beta}_{ii}\left[1 - \hat{z}_i\frac{\phi(\hat{z}_i)}{\Phi(\hat{z}_i)} - \left(\frac{\phi(\hat{z}_i)}{\Phi(\hat{z}_i)}\right)^2\right]}{\bar{x}_i\hat{\beta} + \hat{\sigma}_i\frac{\phi(\hat{z}_i)}{\Phi(\hat{z}_i)}} \tag{11}$$

$$e_{ij} = \frac{\hat{\beta}_{ij}\left[1 - \hat{z}_i\frac{\phi(\hat{z}_i)}{\Phi(\hat{z}_i)} - \left(\frac{\phi(\hat{z}_i)}{\Phi(\hat{z}_i)}\right)^2\right]}{\bar{x}_i\hat{\beta} + \hat{\sigma}_i\frac{\phi(\hat{z}_i)}{\Phi(\hat{z}_i)}} \tag{12}$$

$$where\ \hat{z}_i = \frac{\bar{x}_i\hat{\beta}}{\sigma}$$

The estimated elasticites are listed in Table 5 together with the elasticities estimated from two model approaches applying restrictions on the parameters.

TABLE 5 – ESTIMATED ELASTICITIES FROM THE RESULTS OF THE TOBIT MODEL SYSTEM WITH AND WITHOUT RESTRICTIONS ON THE PARAMETERS

	No restrictions			Restrictions on γ			All restrictions		
	Income Elasticity	Price elasticity		Income Elasticity	Price elasticity		Income Elasticity	Price elasticity	
		Plane	Package		Plane	Package		Plane	Package
Plane tickets	1.12	-0.73	0.33	1.12	-1.57	0.57	0.93	-1.16	0.16
Travel packages	1.36	-0.33	-1.80	1.35	1.06	-2.06	1.41	0.97	-1.97

The income elasticity of travel packages is higher than the one of plane tickets. This relation is observed for all the different applied model specifications. The estimates of 1.1 and 1.4 respective are in line with the findings of the commodity group of transportation and leisure in the aggregated AIDS model.

The conditional own price elasticities state that the purchased quantities of travel packages are more sensitive to price changes than is the case for plane travel. This has actually also turned out to be consistent across the different applied model specifications despite the uncertainty of the parameter estimates. In contrary, the different applied approaches have not provided similar consistent trends concerning the cross price elasticities. In this multivariate model system, the demand for travel packages decreases when the prices of plane tickets increase, whereas the demand for plane tickets increases when the prices of travel packages increase. This actually seems intuitive as travel packages most often also includes plane travelling.

The elasticities are further estimated per year. Generally, the yearly change is not great in magnitude, but during the 12-year period the income elasticity of plane tickets has increased by 1.3 percent and the income elasticity of travel packages has decreased by 2.0 percent. This indicates a change in the perception of the two travel types during the survey period. But while the income elasticity increases continuously during the years, the change within travel packages is observed from 1999 to 2002 and hereafter the income elasticity seems relatively constant. This obvious change within the income elasticity of travel packages corresponds to the observed change in the expenditure share of plane tickets observed in Figure 2 in Section 3.1 as well as the increase in the price of travel packages during a period of relative constant plane ticket prices as illustrated in Figure 2.

Even though the changes in income elasticities have opposite directions, the income elasticity of travel packages is still 19 percent higher than the income elasticity of plane travel in 2007. From these limited changes per year it is not certain that the two income elasticities will intersect in the future.

Due to the uncertainties related to the estimation of γ, two different groups of restrictions are added to the model specification to improve the estimates as listed in Table 5. Both restrictions are similar to the restrictions applied to the AIDS model in (3) and (4): the first group of restrictions is applying the restrictions on γ, whereas the second is applying all the restrictions from the AIDS model.

The applied restrictions improve the significance of the model system, but as the model system only includes two commodities, these applied restrictions have strong impact on the results forcing the four price related parameters to have the same numerical size. By restricting γ, only the price elasticities are affected and differ quite a bit from the parameters of the unrestricted model system. Generally, the elasticities increase with the restrictions and travel packages become a substitute good for plane travel. By further adding restrictions on β and α, the income elasticities change such that plane tickets become a necessity.

6 Concluding remarks

Using the Danish Expenditure survey from 1996 to 2007, this study analyses the relations within expenditures on transportation and leisure with special focus on long distance travelling represented by the expenditures on plane tickets and travel packages. The central question of interest was the elasticities of long distance travel to provide measurements for possible forecasting of the Danes total amount of travelling in relation to economic changes in society. This question does not seem to be commonly handled within the literature and the difficulties related to the variation in prices indicate why.

Both the aggregate demand system modelling with AIDS and the Tobit approach on the disaggregated commodities fall short on estimating sufficient price related parameters, and hence also price elasticities. However, the two applied methods provide realistic and robust income elasticities. Transportation and leisure as a joint commodity, as well as plane tickets and travel packages as separate commodities, are found to be luxury goods. The income elasticity of transportation and leisure is estimated to 1.2, whereas it is 1.1 and 1.4 respectively for plane tickets and travel packages. This implies that if the present growth in wealth continues, the population will generally travel more or e.g. increase the standard of travelling to higher luxury or more unique destinations.

A various number of estimations have been tested for the disaggregated commodities of plane tickets and travel packages, not all included in this paper. All the estimates show the same finding that travel packages are considered as a higher luxury than plane tickets and also a higher luxury than transportation and leisure in general. Even though the lack of variation in prices causes trouble in estimating sufficient price elasticities, the various results also indicate similar conditions that travel packages are far more sensitive to changes in prices than plane travel.

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8 Literature

Amemiya, T. (1974). Multivariate regression and simultaneous equation models when the dependent variables are truncated normal. *Econometrica* 42, 999-1012.

Brännlund, Runar and J. Nordström. (2002). Carbon tax simulations using a household demand model. *European Economic Review* 48.

Chang, C., T. Khamkaew, M. McAlleer. (2010). Estimating Price Effects in an Almost Ideal Demand Model of Outbound Thai Tourism to East Asia. *Kier discussion paper series*. Kyoto Institute of economic research.

Deaton, A. And J. Muellbauer. (1980). An almost Ideal Demand System. The American *Economic Review*, Vol. 70, No. 3, 312-326.

Deaton, A. And J. Muellbauer. (1980b). Economics and consumer behaviour. *Cambridge University Press*

Chern, W. S, K. Ishibashi, K. Taniguchi and Y. Tokoyoma. (2003). Analysis of the food consumption of Japanese households. *Food and agriculture organization of the United Nations*.

Hausman, J. A. (1997). Valuation of New Goods under Perfect and Imperfect Competition. Bresnahan and Gordon, eds. *The Economics of New Goods*. University of Chicago Press, 209-237.

Heckman, J. J. (1979). Sample selection Bias as a Specification Error, *Econometrica*, vol. 47, No. 1, pp. 153-161.

ICP, 2005. *www.ers.usda.gov* accessed the 13/5 2011.

Knudsen, M. (2010). Vurdering af lange rejser, *Aalborg Trafikdage*

Leser, C. E. V., (1963), Forms of Engel functions. *Econometrica*, Vol. 31, pp. 694-703.

Mas-Colell, A., M. D. Whinston and J. R. Green (1995), Microeconomic Theory. *Oxford University Press*

Statistic Denmark (2008). Ferie- og forretningsrejser 2007. *Statistic Denmark*, Copenhagen 2008

Statistic Denmark. (2011). www.statbank.dk (accessed 11/1 2011).

Tobin, J. (1958). Estimation of relationships for limited dependent variables. *Econometrica* 26, 24-36.

Working, H. (1943). Statistical laws of family expenditure, *Journal of the American Statistical Association*, Vol. 38, pp. 43-56.